Naval Submarine Medical Research Laboratory

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Assessment of Headache Incidence during SURVIVEX 2004

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14. ABSTRACT

The extent to which headaches occur among submariners and impact their performance is unknown. The objective of this survey was to evaluate headaches as an issue of concern noted during SURVIVEX 2004, a disabled submarine survival exercise conducted aboard USS SALT LAKE CITY. For four days, the subjects were exposed to carbon dioxide levels above 1.5% and oxygen levels of below 19%. Of the 73 respondents, 47.9% of the subjects experienced a headache during the exercise, with 77.1% describing the pain as severe. The incidence of headache among SURVIVEX subjects needs to be considered in disabled submarine scenario planning.

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Administrative information

The views expressed in this report are those of the author and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, nor the United States Government. The study protocol was approved by the Naval Submarine Medical Research Laboratory Institutional Review Board in compliance with all applicable Federal regulations governing the protection of human subjects.

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SUMMARY

Problem.
The extent to which headaches occur among submariners and impact their performance is unknown. The objective of this survey is to evaluate headache incidence as an issue of concern during SURVIVEX 2004, a simulated disabled submarine exercise.

Findings.
Of the 78 SURVIVEX trial subjects, 73 (94%) returned surveys. Of these, 47.9% reported experiencing a headache during the exercise.

Application.
The implications of headache aboard a disabled submarine (DISSUB) need to be considered in DISSUB scenario planning.

BACKGROUND

There is no published data on the prevalence and overall impact of headaches on sailors in a disabled submarine situation. Etiologies for environmental exposure and onset of headaches are diverse and well documented. Tension headache is the most common primary headache and accounts for 90% of all headaches. Vascular headaches are the second most frequently occurring primary headaches. Such headaches are caused by blood vessel abnormalities and constitute about 8% of all headaches. About 2% of headaches are secondary headaches. Secondary causes of headache in this environment may be due to emotional stress[1], sleep disturbance[2], musculoskeletal dysfunction[3,4], eyestrain from decreased lighting[5], elevated CO_2 exposure[6], and tobacco or caffeine withdrawal.[7] Headache secondary to elevated CO_2 exposure was less likely considering CO_2 levels only rose to a peak of 1.8% as measured by Analox monitor. Higher levels of CO_2 have been shown to cause sleep disturbance among submarine crew[2]. In order to evaluate the incidence of headache during a potential DISSUB scenario, the authors conducted surveys of SURVIVEX 2004 subjects.

METHODS

During SURVIVEX 2004, a simulated sunken submarine trial conducted pier-side on USS SALT LAKE CITY, each of the 78 trial subjects was given a single modified 7-item headache questionnaire on the last day of the exercise (Day # 4). This was performed during the 1-hour Emergency Breathing trial. The first question asked if they experienced a headache during the 4-day trial and the remaining 6 questions were follow-up items specific to the nature and limitations of the headaches for those who did report a headache. Responses to the follow-up questions were on a Likert type scale. However, due to the small group size (n=35) and 2 or less responses occurring in some categories for some items, all responses were converted to equal = 0 if "Never" was the response, and 1 for all others. A converted score = 0 is described as a "No" response, and a converted score of 1 is a "Yes" response. A "Yes" could be a response ranging from rarely to always. A "Rarely" response was not collapsed with "Never" responses because in this context, describing an occurrence as "Rarely" over the course

of only 4 days was a positive response and therefore was chosen to best describe a "Yes" rather than "No" response. Therefore interpretation of these results is whether or not the headaches lead to further discomfort or limitations rather than the amount or magnitude of the discomfort or limitations. Using a chi-square nonparametric statistical test, analyses were done on each item to determine if the number of converted "Yes" responses were statistically different from the number of converted "No" responses (i.e., was the frequency of Yes responses statistically different from the frequency of No responses). It was assumed that a Yes or No response could have occurred for each item with equal probability.

RESULTS

A total of 73 of 78 (93.6%) test subjects returned the questionnaire at the end of the trial. Out of these responders, 35 (47.9%) reported experiencing a headache during the exercise. Of those who reported a headache, 77.1% described the pain as severe at times and 65.7% wished they could lie down when experiencing a headache. Regarding their work, 37.1% stated it did limit their ability to perform their work or other tasks, 48.6% reported feeling too tired to do their work or other activities, and 60.0% reported they were limited in their ability to concentrate on work or activities because of their headache. A total of 82.9% reported feeling irritable because of a headache. Table one lists these items and the response rates. Only the Severe Pain and Irritability item responses were found to differ significantly in converted response rates.

Table 1. Responses to Follow-up Items.

Item	No %	Yes %	χ^2	*P*
If you experienced a headache, was the pain severe?	22.9	77.1	10.31	.001
When you had a headache, did you wish you could lie down?	34.3	65.7	3.46	.06
Did your headache(s) limit your ability to perform your work or other tasks?	62.9	37.1	2.31	.13
Did you feel too tired to do your work or activities because of your headache(s)?	51.4	48.6	0.03	.87
Did you feel irritable because of your headache(s)?	17.1	82.9	15.11	<.001
Did your headache(s) limit your ability to concentrate on work or activities?	40.0	60.0	1.40	.24

Degrees of freedom for all tests = 1.

CONCLUSIONS AND DISCUSSION

Almost half of the crew subjects that were surveyed reported a headache and of these most reported the pain as severe. Additionally, a significant amount stated they felt irritable as a result. In the SURVIVEX 2004 trial, subjects were exposed to a carbon dioxide level of >1.0% for 24 hours (from hour 48-72) and >1.5% for 12 hours (from hour 60-72). Subjects breathed oxygen at a level of <19.0% for 58 hours (from hour 15-58) in the compartment in which temperatures were greater than 80 deg. F. for 30 hours and humidity was greater than 70% for 60 hours[8]. It is likely that these environmental conditions contributed to the high headache rate. Previous studies have shown that elevated carbon dioxide levels, low oxygen levels, uncomfortable temperature and humidity levels, and difficulty sleeping can cause headaches.[5,9,10] Additionally, smoking during the trial was prohibited and nicotine withdrawal can also cause headaches. However, attempts to control for nicotine withdrawal were made by offering nicotine gum and patches to crew who smoked. Some of these members did switch to smokeless tobacco during the exercise.

The implications of headache in DISSUB crewmembers, needs to be considered, possibly by evaluating submariners during normal underway working conditions and comparing those results. Lack of a standardized questionnaire, a baseline headache questionnaire, randomization of subjects selected to participate, and a small sample size are limitations of this evaluation that may be addressed in any future exercise.

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